Comments by Beacon Power Corporation on the Alternative Energy Portfolio Standard, Chapter 169 of the Acts of 2008

Summary

Beacon Power suggests equating the value of an Alternative Energy Certificate (AEC) to that of a Renewable Energy Certificate (REC) by setting the Alternative Compliance Payment (ACP) amount for both programs equal to each other, and then adjusting the amount of AECs a resource receives based on its CO_2 savings as compared to the CO_2 savings of 1 MWh of renewable energy. Based on our analysis one MWh of energy provided by flywheel energy storage equals the CO_2 savings of 0.22 MWh of renewable energy. Based on this method, a flywheel energy storage resource should receive one AEC for every 4.54 MWh of energy injected onto the grid.

Introduction

Beacon Power Corporation's Smart Energy Matrix™ is a flywheel energy storage system that provides a long-term sustainable solution for the ancillary service of Regulation on the electricity grid. The core component of the Smart Energy Matrix™ systems is Beacon's 4th-generation 25 kWh/100 kW model based on Beacon's Patented Co-mingled Rim Technology® (PCRT). Its long-life, low-maintenance design and highly cyclic capability is intended to deliver a clean, cost-effective alternative to conventional fossil fuel-based frequency regulation methods.

The Green Communities Act of 2008 establishes a new program called the Alternative Energy Portfolio Standard (APS) which is designed to increase the technological diversity providing services to the electrical grid in Massachusetts. There are a limited number of technologies that have been pre-selected as qualified to participate in this program. These technologies vary greatly in their service to the electrical grid and the impact they have on the environment. In response to the Department of Energy Resources (DOER) request for input on how to implement the APS program, Beacon Power submits the following comments.

How should the Annual APS percentage rate be determined, and what should that rate be?

Beacon Power suggests that the DOER consider the current market penetration of each APS qualified technology and the level of penetration that theses resources could practically achieve over the course of the program. These levels should guide the DOER towards a percentage that is both realist and encourages the development of Alternative Energy resources. Using the method discussed below, the Alternative Energy Certificates (AEC) generated by a 5 MW Beacon Power facility would be equivalent to buying one AEC for every megawatt-hour associated with 0.00011% of kWh sales. If Beacon were to approach a majority share of the regulation market in New England this percentage would only increase to 0.00135% of load.

What criteria should be required for any of the specified eligible technologies?

Beacon suggests using the criteria for the RPS as a template for the APS. A resource should be interconnected through the Independent Service Operator of New England (ISO-NE); be monitored by an independent third party participating in the New England Power Pool Geographic Information System (NEPOOL GIS); and have a positive environmental impact.

What should the Alternative Compliance Payment (ACP) amount be for APS, and how should it be calculated?

For market transparency and ease of administration, Beacon Power suggests equating the value of an AEC to that of a Renewable Energy Certificate (REC) by setting the Alternative Compliance Payment (ACP) amount for both programs equal to each other, and then adjusting the amount of AECs a resource receives based on its CO_2 savings as compared to the CO_2 savings of 1 MWh of renewable energy. The ACP amount would be \$58.58 per AEC[1].

Each qualified alternative technology will vary greatly in the manner in which they operate, the service they provide to the grid, and how they avoid carbon dioxide emissions. These inherent differences create a need for a standardized metric to which the technology's benefit can be measured; we recommend that the CO_2 emission savings of one MWh of clean energy should be this metric. This would ensure fair, equitable, and appropriate program across a wide range technologies.

For example, flywheel energy storage has a CO_2 savings of 207[2] lbs per MWh it injects onto the grid. Currently in the service area of ISO-NE one MWh of electricity generates 960 lbs of CO_2[3]. That means flywheel will have to inject 4.54 MWh of energy onto the grid in order to have the same CO_2 savings as a Renewable Energy generating source, or said another way 0.22 MWh of renewable energy equals one MWh of energy provided by flywheel energy storage. Based on this method, a flywheel energy storage resource should receive one AEC for every 4.54 MWh of energy injected onto the grid.

To qualify for AECs each technology should have to supply evidence of their CO_2 reductions and be able to correlate those savings to an easily metered value. Beacon Power suggests using the number of MWh injected to the grid. This parameter can be metered, verified, and tracked by the NEPOOL GIS. Using a technology's CO_2 savings per MWh and the average CO_2 produced per MWh of electricity in ISO-NE a Certificate Equivalence Ratio[4] (CER) can be determined for every technology. This is defined by Equation 1. The equation for allocation of AECs is given by Equation 2. Equation 3 is the relationship

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[1] This price based off of a value of \$50.00 in 2003 and adjusted based on the Consumer Price Index (Department of Energy Resources, 2008).
[2] This number is explained later based on two different reports (Fioravanti & Enslin, 2006), (Makarov, Ma, Lu, & Nguyen, 2008)
[3] (2007 ISO-NE Emissions Data)
[4] Note that the units of the CER are actually AECs per MWh.
(lbs CO_2 reduce / Alternative MWh) / (lbs CO_2 reduced/ REC) = RECs / Alternative MWh
 Since one AEC = one REC, the final units of the R_{CO2} are AECs/ Alternative MWh

between one MWh of renewable energy, one REC, one AEC, and technology specific number of MWhs of energy provided by an APS qualified resource.

Equation 1

$$R_{CO2} = \frac{Savings_{CO_2/kWh}}{960\ lbs\ CO_2}$$

Where:

$Savings_{CO_2/kWh} = lbs\ CO_2\ Reduction/MWh\ for\ an\ APS\ qualified\ resource$

$960\ lbs\ CO_2 = lbs\ CO_2\ associated\ with\ one\ REC\ in\ New\ England$

Equation 2

$$Amount\ AECs = R_{CO_2} \times Metered\ Energy$$

Where:

$R_{CO2} = $ **Credit Equivalence Ration** (*Number of AECs awarded per MWh*)

$Metered\ Energy = The\ measured\ amount\ of\ energy\ injected\ to\ the\ grid\ in\ MWh$

Equation 3

$$1\ MWh\ Renewable = REC = AEC = \frac{1}{R_{CO_2}}\ MWh\ Alternative$$

Table 1 shows the relationship between the number of MWhs an alternative energy source must generate or inject to the grid to earn one AEC.

Table 1: Allocation of AEC based on Certificate Equivalence Ratio

Certificate Equivalence Ratio	MWh Needed to Earn one AEC
R_{CO2}	MWh
0.10	10.00
0.20	5.00
0.30	3.33
0.40	2.50
0.50	2.00
0.60	1.67
0.70	1.43
0.80	1.25
0.90	1.11
1.00	1.00

Example: Beacon Power

KEMA Inc. performed an emissions analysis of Beacon Power's flywheel energy storage technology under contract by Sandia National Laboratories as part of Department of Energy (DOE) program[5].

Table 2 shows a summary of the CO_2 reductions associated with using Beacon Power's flywheel energy storage to provide Regulation service in ISO-NE.

Table 2: Beacon Power's CO_2 Savings and Certificate Equivalence Ratio

Flywheel Savings	CO_2	R_{CO2}
ISO-NE	lbs / MWh$_{INJECTED}$	Credit Equivalence Ratio
Coal	452	0.47
Natural Gas	**207**	**0.22**
Pump Storage	87	0.09

According to data collected by Energy Velocity, 94.6% of the energy produced by cycling units in New England is fueled by natural gas[6]. More importantly, our CER should be based on the fuel source of the marginal unit we displace in New England which is natural gas. Therefore a baseline value of 0.22 is assumed for Beacon Power's CER.

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[5] (Fioravanti & Enslin, 2006)
[6] (Ventyx, 2008)

Equation 1 for Beacon Power

$$R_{CO2} = \frac{Savings_{CO_2/kWh}}{960 \; lbs \; CO_2} = \frac{207}{960} = 0.22$$

Equation 2 for Beacon Power

$$AECs = R_{CO_2} \times Metered \; Energy = 0.22 \; x \; Metered \; Energy$$

Therefore, for each MWh of energy that is recycled back onto the grid using Beacon Power's flywheel based energy storage system, Beacon will receive 0.22 AECs that are equivalent in both monetary and social value to that of 0.22 RECs.

What specific means of monitoring and verification will be necessary for compliance with APS regulation?

To qualify for AECs each technology should have to supply evidence of their CO_2 reductions and be able to correlate those savings to an easily metered value. Beacon Power suggests using the number of MWh injected to the grid. This parameter can be metered, verified, and tracked by the NEPOOL GIS. Each technology's CER should be reevaluated once every two years using NEPOOL GIS data. This will take into account changes in the technology's savings as well as any change to the equivalent CO_2 savings of a clean MWh over the course of the year.

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References

APX Environmental Markets. (2008). 2007 ISO-NE Emissions Data. Santa Clara, CA. Retrieved from APX Environmental Markets.

Department of Energy Resources. (2008, January 22). *Adjustment of the Alternative Compliance Payment (ACP) Rate for Compliance Year 2008*. Retrieved October 15th, 2008, from http://www.mass.gov/Eoeea/docs/doer/rps/acp08.pdf

Fioravanti, R., & Enslin, J. (2006). *Emissions Comparison of a 20 MW Flywheel-based Frequency Regulation Plant.* Raleigh, NC: KEMA Inc.

Makarov, Y., Ma, J., Lu, S., & Nguyen, T. (2008). *Assessing the Value of Regulation Resources Based on Their Time Response Characteristics.* Richland, WA: Pacifici Northwest National Laboratories.

Ventyx. (2008). Generating Unit Capacity Data Set. Atlanta, GA 30339.